

Figure 1

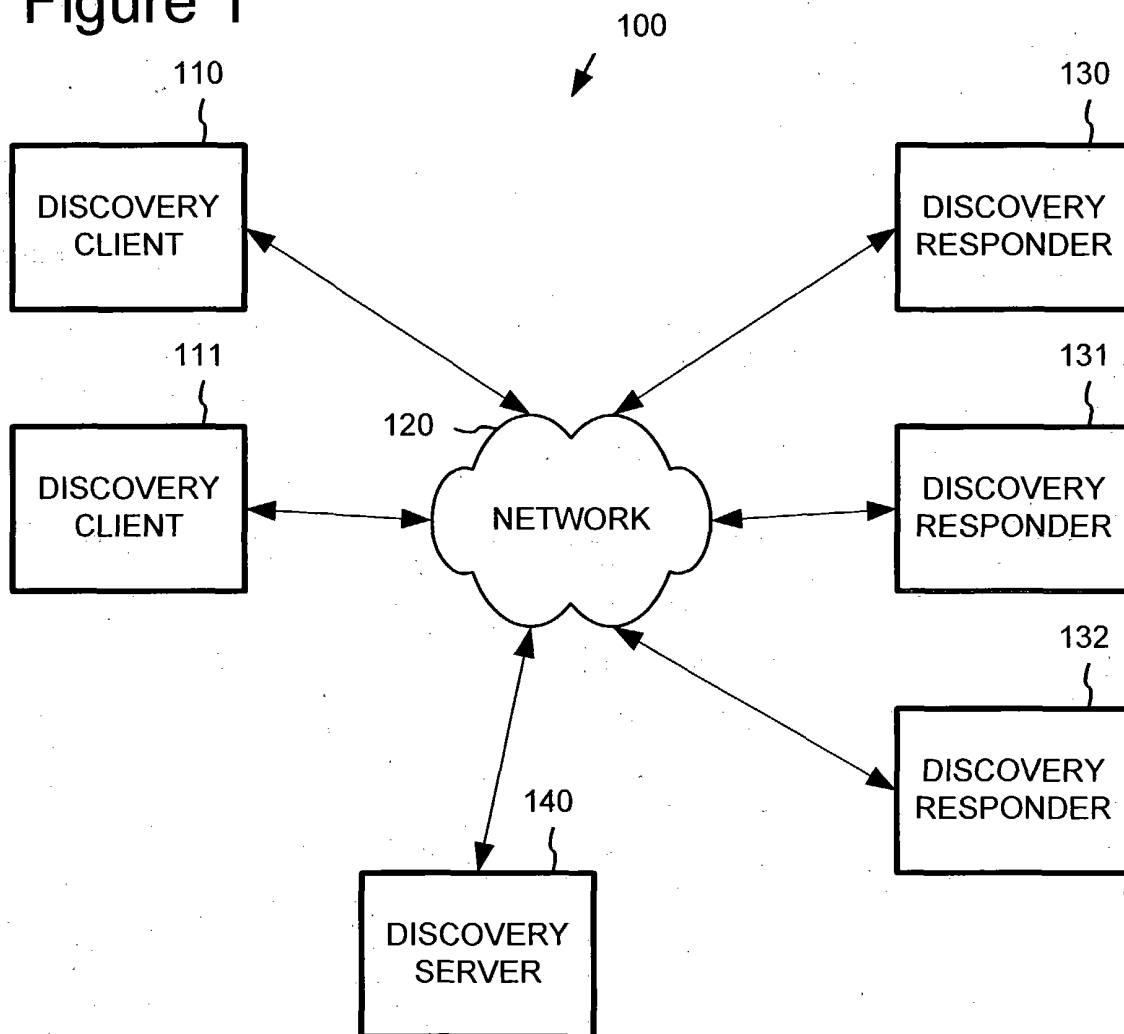


Figure 2A

```
<wsdl:definitions
  xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:disc="http://schemas.upnp.org/2003/01/discovery"
  targetNamespace="http://schemas.upnp.org/2003/01/discovery"
>

  <wsdl:types>
    <xs:schema>
      <xs:import namespace="http://schemas.xmlsoap.org/ws/2002/12/
discovery"
                  schemaLocation="discovery.xsd" />
    </xs:schema>
  </wsdl:types>

  <!-- this portType is implemented by the multicast channel in ad hoc mode -->
  <wsdl:portType name="ServiceDiscovery" >
    <wsdl:operation name="AnnounceService" >
      <wsdl:input message="disc:AnnounceService" />
    </wsdl:operation>
    <wsdl:operation name="ByeBye" >
      <wsdl:input message="disc:ByeBye" />
    </wsdl:operation>
    <wsdl:operation name="Find" >
      <wsdl:input message="disc:Find" />
    </wsdl:operation>
  </wsdl:portType>

  <wsdl:portType name="DiscoverySink" >
    <wsdl:operation name="FindResponse" >
      <wsdl:input message="disc:FindResponse" />
    </wsdl:operation>
  </wsdl:portType>

  <!-- this portType is implemented by the discovery server -->
  <wsdl:portType name="DiscoveryServer" >
    <wsdl:operation name="AnnounceService" >
      <wsdl:input message="disc:AnnounceService"/>
      <wsdl:output message="disc:AnnounceServiceResponse"/>
    </wsdl:operation>
    <wsdl:operation name="ByeBye" >
      <wsdl:input message="disc:ByeBye"/>
      <wsdl:output message="disc:ByeByeResponse"/>
    </wsdl:operation>
    <wsdl:operation name="Find" >
      <wsdl:input message="disc:Find"/>
      <wsdl:output message="disc:FindResponse"/>
    </wsdl:operation>
  </wsdl:portType>
```

Figure 2B

```
<!-- subordinate message constructs -->
<wsdl:message name="Find" >
  <wsdl:part name="parameters" element="disc:Find" />
</wsdl:message>
<wsdl:message name="FindResponse" >
  <wsdl:part name="parameters" element="disc:FindResponse" />
</wsdl:message>
<wsdl:message name="AnnounceService" >
  <wsdl:part name="parameters" element="disc:AnnounceService" />
</wsdl:message>
<wsdl:message name="AnnounceServiceResponse" >
  <wsdl:part name="parameters" element="disc:AnnounceServiceResponse" />
</wsdl:message>
<wsdl:message name="ByeBye" >
  <wsdl:part name="parameters" element="disc:ByeBye" />
</wsdl:message>
<wsdl:message name="ByeByeResponse" >
  <wsdl:part name="parameters" element="disc:ByeByeResponse" />
</wsdl:message>
</wsdl:definitions>
```

Figure 3A

```
<xs:schema
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  xmlns:wsp="http://schemas.xmlsoap.org/ws/2002/12/policy"
  xmlns:disc="http://schemas.upnp.org/2003/01/discovery"
  targetNamespace="http://schemas.upnp.org/2003/01/discovery"
  elementFormDefault="unqualified"
>
  <xs:import namespace="http://schemas.xmlsoap.org/ws/2002/12/policy"
    schemaLocation="Policy.xsd"/>

  <!-- these four GEDs are discovery message formats (ignoring header content) -->
  <xs:element name="Find" type="disc:FindType" />
  <xs:element name="FindResponse" type="disc:FindResponseType" />
  <xs:element name="AnnounceService" type="disc:AnnounceServiceType" />
  <xs:element name="AnnounceServiceResponse"
    type="disc:AnnounceServiceResponseType" />
  <xs:element name="ByeBye" type="disc:ByeByeType" />
  <xs:element name="ByeByeResponse" type="disc:ByeByeResponseType" />

  <!-- FindContext type -->
  <xs:complexType name="FindContext" >
    <xs:sequence>
      <xs:element name="filterContext" type="xs:anyType" minOccurs="0"/>
      <xs:element name="callbackContext" type="xs:anyType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
  <xs:element name="FindContext" type="disc:FindContext"/>

  <!-- Find message type -->
  <xs:complexType name="FindType" >
    <xs:sequence>
      <xs:element name="scope" type="xs:anyURI" minOccurs="0"/>
      <xs:element name="key" type="xs:anySimpleType" minOccurs="0"/>
      <xs:element name="filter" type="xs:string" minOccurs="0"/>
      <xs:element name="findContext" type="disc:FindContext"
minOccurs="0"/>
      <xs:element name="sizeLimit" type="xs:int" minOccurs="0"/>
      <xs:element name="pageContext" type="xs:anyType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>

  <!-- Three predefined key types of the Find message -->
  <xs:simpleType name="Type" >
    <xs:restriction base="xs:QName"/>
  </xs:simpleType>
  <xs:simpleType name="DeviceType" >
    <xs:restriction base="xs:QName"/>
  </xs:simpleType>
  <xs:simpleType name="EndpointID" >
    <xs:restriction base="xs:string"/>
  </xs:simpleType>
```

Figure 3B

```
<!-- FindResponse message type -->
<xs:complexType name="FindResponseType" >
  <xs:sequence>
    <xs:element name="entries" type="disc:ServiceEntries"/>
    <xs:element name="callbackContext" type="xs:anyType" minOccurs="0"/>
  </xs:sequence>
  <xs:element name="pageContext" type="xs:anyType" minOccurs="0"/>
  <xs:element name="status" type="disc:Status" minOccurs="0"/>
</xs:complexType>

<xs:complexType name="Status">
  <xs:sequence>
    <xs:element name="details" type="xs:anyType"/>
    <xs:element name="description" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<!-- Some standard failure types -->
<xs:complexType name="SizeLimitExceeded"/>
<xs:complexType name="InvalidPageContext"/>

<!-- Announce message type -->
<xs:complexType name="AnnounceServiceType" >
  <xs:sequence>
    <xs:element name="endpointID" type="xs:anyURI"/>
    <xs:element name="configNumber" type="xs:unsignedInt"/>
    <xs:element name="statelessBootTime" type="xs:unsignedInt"/>
  </xs:sequence>
</xs:complexType>

<!-- AnnounceResponse message type -->
<xs:complexType name="AnnounceServiceResponseType"/>

<!-- ByeBye message type -->
<xs:complexType name="ByeByeType">
  <xs:sequence>
    <xs:element name="endpointID" type="xs:anyURI"/>
    <xs:element name="statelessBootTime" type="xs:unsignedInt"/>
  </xs:sequence>
</xs:complexType>

<!-- ByeByeResponse message type -->
<xs:complexType name="ByeByeResponseType"/>

<!-- The following attribute group is defined to support the
      SOAP reference(pointer) semantics -->
<xs:attributeGroup name="SOAPReferenceAttributes">
  <xs:attribute name="id" type="xs:ID"/>
  <xs:attribute name="idref" type="xs:IDREF"/>
</xs:attributeGroup>
```

Figure 3C

```
<!-- Discovery SOAP headers -->
<xs:complexType name="Identifier">
  <xs:simpleContent>
    <xs:extension base="xs:anyURI">
      <!-- Any attributes (more precisely qualified global
attributes)
      like soap:mustUnderstand -->
      <xs:anyAttribute processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:element name="MessageID" type="disc:Identifier"/>
<xs:element name="CorrelationID" type="disc:Identifier"/>
<xs:element name="To" type="disc:Identifier"/>

<xs:complexType name="ReplyTo">
  <xs:sequence>
    <xs:element name="to" type="xs:anyURI"/>
    <xs:element name="transportAddress" type="xs:anyURI"/>
  </xs:sequence>
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>
<xs:element name="ReplyTo" type="disc:ReplyTo"/>

<xs:complexType name="Idempotent">
  <!-- Any attributes (more precisely qualified global attributes)
  like soap:mustUnderstand -->
  <xs:anyAttribute processContents="lax"/>
</xs:complexType>
<xs:element name="Idempotent" type="disc:Idempotent"/>

<xs:complexType name="TTL">
  <xs:simpleContent>
    <xs:extension base="xs:int">
      <!-- Any attributes (more precisely qualified global
attributes)
      like soap:mustUnderstand -->
      <xs:anyAttribute processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:element name="TTL" type="disc:TTL"/>
```

Figure 3D

```
<!-- A set of common types -->
<xs:simpleType name="TypeInfo">
  <xs:list itemType="xs:QName"/>
</xs:simpleType>

<xs:element name="anyType" type="xs:anyType"/>
<xs:complexType name="anyTypes">
  <xs:sequence>
    <xs:element ref="disc:anyType" minOccurs="0" maxOccurs="unbounded"/>
  </xs:sequence>
</xs:complexType>

<xs:element name="Scope" type="xs:anyURI" substitutionGroup="disc:anyType"/>
<xs:complexType name="Scopes">
  <xs:complexContent>
    <xs:restriction base="disc:anyTypes">
      <xs:sequence>
        <xs:element ref="disc:Scope" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>

<xs:complexType name="EndpointInfo" >
  <xs:sequence>
    <xs:element name="endpointID" type="xs:anyURI"/>
    <xs:element name="implementationType" type="xs:QName" minOccurs="0"/>
    <xs:element name="typeInfo" type="disc:TypeInfo" minOccurs="0"/>
    <xs:element name="policy" type="wsp:PolicyExpression" minOccurs="0"/>
    <xs:element name="extensions" type="disc:anyTypes" minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="disc:SOAPReferenceAttributes"/>
</xs:complexType>
<xs:element name="EndpointInfo" type="disc:EndpointInfo"
substitutionGroup="disc:anyType"/>
<xs:complexType name="EndpointInfos">
  <xs:complexContent>
    <xs:restriction base="disc:anyTypes">
      <xs:sequence>
        <xs:element ref="disc:EndpointInfo" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>

<!-- Transport address policy assertion -->
<xs:element name="Address" type="xs:anyURI"/>
```

Figure 3E

```
<!-- The following is the definition of the service schema entry -->
<xs:complexType name="ServiceEntry" >
  <xs:sequence>
    <xs:element name="friendlyName" type="xs:string" minOccurs="0"/>
    <xs:element name="configNumber" type="xs:unsignedInt" minOccurs="0"/>
    <xs:element name="scopes" type="disc:Scopes" minOccurs="0"/>
    <xs:element name="endpointInfo" type="disc:EndpointInfo"/>
    <xs:element name="deploymentProperties" type="disc:anyTypes"
minOccurs="0"/>
  </xs:sequence>
  <xs:attributeGroup ref="disc:SOAPReferenceAttributes"/>
</xs:complexType>
<xs:element name="ServiceEntry" type="disc:ServiceEntry"
substitutionGroup="disc:anyType"/>
<xs:complexType name="ServiceEntries">
  <xs:complexContent>
    <xs:restriction base="disc:anyTypes">
      <xs:sequence>
        <xs:element ref="disc:ServiceEntry" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>

<!-- The following is the definition of the discovery service schema entry --
>
<xs:complexType name="DiscoveryServiceEntry" >
  <xs:complexContent>
    <xs:extension base="disc:ServiceEntry">
      <xs:sequence>
        <xs:element name="supportedScopes" type="disc:Scopes"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:element name="DiscoveryServiceEntry" type="disc:DiscoveryServiceEntry"
substitutionGroup="disc:ServiceEntry"/>
<xs:complexType name="DiscoveryServiceEntries">
  <xs:complexContent>
    <xs:restriction base="disc:ServiceEntries">
      <xs:sequence>
        <xs:element ref="disc:DiscoveryServiceEntry" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>
```


Figure 3F

```
<!--The following is the definition of the device schema entry -->
<xs:complexType name="DeviceEntry" >
  <xs:complexContent>
    <xs:extension base="disc:ServiceEntry">
      <xs:sequence>
        <xs:element name="manufacturerName" type="xs:string"/>
        <xs:element name="serialNumber" type="xs:string"/>
        <xs:element name="entries" type="disc:ServiceEntries"
minOccurs="0"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:element name="DeviceEntry" type="disc:DeviceEntry"
substitutionGroup="disc:ServiceEntry"/>
<xs:complexType name="DeviceEntries">
  <xs:complexContent>
    <xs:restriction base="disc:ServiceEntries">
      <xs:sequence>
        <xs:element ref="disc:DeviceEntry" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:restriction>
  </xs:complexContent>
</xs:complexType>
</xs:schema>
```

Figure 4

```
<entry xsi:type="upnp:PrinterCopierDeviceEntry"> <!-- PrinterCopierDeviceEntry
extends
    DeviceEntry which in-turn extends
    ServiceEntry -->
    <friendlyName>XX Color Printer-Copier in the den</friendlyName>
    <configNumber>28945</configNumber>
    <scopes>
        <upnp:scope>/myhouse/floor1/den</upnp:scope>
        <upnp:scope>/mymachine/devices/usb</upnp:scope>
    </scopes>
    <endpointInfo>
        <endpointID>uuid:94256bb9-edda-4947-9d54-9f990b5f4ff8</endpointID>
        <implementationType xmlns:x="http://xx.com/printerCopiers/"
">x:XPrinterCopier</implementationType>
        <policy>
            <wsp:ExactlyOne wsp:Usage="wsp:Required">
                <disc:Address>tcp://[FF80::1234:5678:90AB:CDEF]:1900</
disc:Address>
                <disc:Address>http://my-home.example.net/printerCopier</
disc:Address>
            </wsp:ExactlyOne>
            <wsp:Authentication ...../>
        </policy>
    </endpointInfo>
    <manufacturerName>XX Company< manufacturerName> <!-- DeviceEntry fields -->
    <serialNumber>XX-Printer-12345</serialNumber>
    <entries>
        <upnp:serviceEntry>
            <friendlyName>XX Color printer service in the den</friendlyName>
            <endpointInfo>
                <endpointID>uuid:7b7ee0f6-d5a0-4e56-8fe6-1e56c8ade98d</endpointID>
                <implementationType xmlns:x="http://xx.com/printers/">x:XPrinter</
implementationType>
                <typeInfo xmlns:upnp="upnp.org:v2:printers">upnp:StandardPrinter</
typeInfo>
                <policy>
                    <disc:Address>tcp://192.168.1.1:95/Printer</disc:Address>
                </policy>
            </endpointInfo>
        </upnp:ServiceEntry>
        <upnp:serviceEntry>
            <friendlyName>XX Color copier service in the den</friendlyName>
            <endpointInfo>
                <endpointID>uuid:15a38098-82dc-4b6d-8355-6ea29c8e832f</endpointID>
                <implementationType xmlns:x="http://xx.com/copiers/">x:XCopier</
implementationType>
            </endpointInfo>
        </upnp:ServiceEntry>
    </entries>
    <color>true</color> <!-- PrinterEntry fields -->
    <supportedPaperSizes>A4 Legal</supportedPaperSizes>
    <supportedOrientations>Portrait Landscape</ supportedOrientations>
</entry>
```

Figure 5

```
<soap:Envelope>
  <soap:Header>
    <disc:MessageID >uuid:a56a9e10-7a79-4840-82a4-626428ab6499</
disc:MessageID>
    <disc:To>http://schemas.upnp.org/2003/01/discovery/discovery-uri</disc:To>
    <disc:ReplyTo> <!-- send responses here -->
      <to>target-for-response</to>
      <transportAddress>http://myclient.mycompany.net/soap</
transportAddress>
    </disc:ReplyTo>
    <disc:Idempotent/>
    <disc:TTL>60</disc:TTL>                                <!-- ttl for this message expressed in
seconds -->
  </soap:Header>
  <soap:Body>
    <disc:Find xmlns:disc="http://schemas.upnp.org/2003/01/discovery/">
      <scope>/myhouse/floor1</scope>
      <key xsi:type="disc:DeviceType"
xmlns:qns="upnp.org:v2:Printers">qns:Printer</key>
      <sizeLimit>50</sizeLimit>
      <pageContext/>
    </disc:Find>
  </soap:Body>
</soap:Envelope>
```

Figure 6A

```
<soap:Envelope>
  <soap:Header>
    <disc:MessageID>uuid:34f1fd44-ad28-4841-b51c-26b20c779047</disc:MessageID>
    <disc:CorrelationID>uuid:a56a9e10-7a79-4840-82a4-626428ab6499</disc:CorrelationID>
    <disc:To>target-for-response</disc:To>
  </soap:Header>
  <soap:Body>
    <disc:FindResponse>
      <entries>
        <entry xsi:type="upnp:PrinterCopierDeviceEntry"> <!--
PrinterCipierDeviceEntry extends
DeviceEntry which in-turn extends
ServiceEntry -->
friendlyName>    <friendlyName>XX Color Printer-Copier in the den</friendlyName>
                  <configNumber>28945</configNumber>
                  <scopes>
                    <upnp:scope>/myhouse/floor1/den</upnp:scope>
                    <upnp:scope>/mymachine/devices/usb</upnp:scope>
                  </scopes>
                  <endpointInfo>
                    <endpointID>uuid:94256bb9-edda-4947-9d54-9f990b5f4ff8</endpointID>
                    <implementationType xmlns:x="http://xx.com/printercopiers/">x:XPrinterCopier</implementationType>
                    <policy>
                      <wsp:ExactlyOne wsp:Usage="wsp:Required">
                        <disc:Address>tcp://[FF80::1234:5678:90AB:CDEF]:1900/
</disc:Address>
                        <disc:Address>http://my-home.example.net/printerCopier</disc:Address>
                      </wsp:ExactlyOne>
                      <wsp:Authentication ...../>
                    </policy>
                  </endpointInfo>
                  <manufacturerName>XX Company< manufacturerName> <!-- DeviceEntry
fields -->
                  <serialNumber>XX-Printer-12345</serialNumber>
```

Figure 6B

```
<services>
  <upnp:serviceEntry>
    <friendlyName>XX Color printer service in the den</
friendlyName>
    <endpointInfo>
      <endpointID>uuid:7b7ee0f6-d5a0-4e56-8fe6-
1e56c8ade98d</endpointID>
      <implementationType xmlns:x="http://xx.com/printers/
">x:XPrinter</implementationType>
      <typeInfo
xmlns:upnp="upnp.org:v2:printers">upnp:StandardPrinter</typeInfo>
      <policy>
        <disc:Address>tcp://192.168.1.1:95/Printer</
disc:Address>
        </policy>
      </endpointInfo>
    </upnp:ServiceEntry>
  <upnp:serviceEntry>
    <friendlyName>XX Color copier service in the den</
friendlyName>
    <endpointInfo>
      <endpointID>uuid:15a38098-82dc-4b6d-8355-
6ea29c8e832f</endpointID>
      <implementationType xmlns:x="http://xx.com/copiers/
">x:XCopier</implementationType>
      </endpointInfo>
    </upnp:ServiceEntry>
</services>
<color>true</color> <!-- PrinterEntry fields -->
<supportedPaperSizes>A4 Legal</supportedPaperSizes>
<supportedOrientations>Portrait Landscape</
supportedOrientations>
</entry>
</entries>
</disc:FindResponse>
</soap:Body>
</soap:Envelope>
```

Figure 7

```
<soap:Envelope>
  <soap:Header>
    <disc:MessageID >uuid:9e519214-8896-49fa-97e1-9936f10667ee</
disc:MessageID>
    <disc:To>http://schemas.upnp.org/2003/01/discovery/discovery-uri</
disc:To>
    <disc:ReplyTo> <!-- send queries here -->
      <to>target-for-response</to>
      <transportAddress>http://myclient.mycompany.net/soap</
transportAddress>
    </disc:ReplyTo>
    <disc:Idempotent/>
    <disc:TTL>30</disc:TTL>          <!-- ttl for this message expressed in
seconds -->
  </soap:Header>
  <soap:Body>
    <disc:Announce>
      <endpointID>uuid:94256bb9-edda-4947-9d54-9f990b5f4ff8</
endpointID>
      <configNumber>74285</configNumber>
      <statelessBootTime>5643672</statelessBootTime>
    </disc:Announce>
  </soap:Body>
</soap:Envelope>
```

Figure 8

```
<soap:Envelope>
  <soap:Header>
    <disc:MessageID>uuid:dde0ab88-6928-4e4e-b7e4-93f7dfe5ff1d</
disc:MessageID>
    <disc:To>Http://schemas.upnp.org/2003/01/discovery/discovery-uri</
disc:To>
    <disc:Idempotent/>
    <disc:TTL>30</disc:TTL>      <!-- ttl for this message expressed in
seconds -->
  </soap:Header>
  <soap:Body>
    <disc:ByeBye>
      <endpointID>uuid:94256bb9-edda-4947-9d54-9f990b5f4ff8</
endpointID>
      <statelessBootTime>5643672</statelessBootTime>
    </disc:ByeBye>
  </soap:Body>
</soap:Envelope>
```

Figure 9

```
t = 1000; // 1000 milliseconds
for (i = 0; i < 4; i++, t = 2*t)
{
    x = uniform_random(0, t);
    wait(x); // wait a random interval of x milliseconds
    if (server_is_configured)
    {
        Send_Announce_Message_to_server();
        if (successful_transmission)
            Break;
    } else {
        if (IPv4_capable)
            Send_Announce_Message_to_IPv4_URL();
        if (IPv6_capable)
            Send_Announce_Message_to_IPv6_URL();
    }
}
```


Figure 10

